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Who's more creative, experts or the crowd?

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ABSTRACT

Prior literature has indicated a remarkable change in the role of the crowd. Gradually, the crowd, in the process of interacting with firms, is no longer limited to providing demand information alone; rather, the crowd sometimes start participating either partially or fully in product innovation. Such change is based on an underlying assumption that the crowd (or customers) would provide creative thinking and thus help firms with product innovation. However, since this assumption has not been formally tested, this paper explores the difference between experts and the crowd in terms of generating creative ideas for products. By launching two experiments on Amazon's Mechanical Turk platform and analyzing the resulting data, I found that a difference does exist and is significantly moderated by the extent of information asymmetry embedded across different products.

Keywords

Web-based Crowdsourcing Innovation, Creativity, Information Asymmetry

INTRODUCTION

Who should we turn to for creative thinking? In the context of product innovation, we conventionally think of creativity as being the province of experts, people with sufficient knowledge about a specific product. But research suggests that the crowd, in addition to experts, is also a great source for creativity since crowd members are familiar with these products as a result of their own purchases (e.g. Chan and Lee, 2004; Howe, 2006; von Hippel, 2002). More importantly, theories suggest that, in the process of interacting with firms, the crowd is no longer limited to providing demand information alone; rather, the crowd has started to participate either partially or fully in product innovation. These theories, however, are based on an underlying assumption that the crowd (or customers) would provide creative input and thus help firms with product innovation. However, this assumption has yet to be tested. Can the crowd, consisting mainly of novices, help firms innovate?

There are two competing streams of research that focus on the legitimacy of the crowd's creative thinking. One stream (Bidault and Cummings, 1994; Bruce, Leverick, Littler, and Wilson, 1995; Dolan and Matthew, 1993; Leonard-Barton, 1999; Schrader and Copfert, 1998) suggests that customers cannot facilitate product innovation by directly participating because they are not knowledgeable enough regarding how products are made. In contrast, the other stream (e.g. von Hippel, 2002) claims that it is

refreshing to have customers provide creative ideas or participate in product innovation since they can use their consumption experiences to assist firms with product innovations.

In order to help understand these competing claims, a test is necessary. When selecting products for experts and non-experts to innovate with, a single product characteristic will be used as the criterion to select products for my experiments. Specifically, this criterion is described as the product-relevant information asymmetry (Brush and Artz, 1999; Nelson, 1970) which suggests that all goods/services can be placed on a continuum ranging from 'easy to evaluate' (search products) to 'difficult to evaluate' (credence products) (Brush and Artz, 1999; Nelson, 1970). Although the literature on information asymmetry is applicable to customer's external product search activities, the emphasis on the extent of information shared by both product providers and customers can be built upon in this paper. Considering the definition of information asymmetry, I have hypothesized: whether inside experts' product ideas and outside non-experts' product ideas differ in creativity depending on the level of product information asymmetry.

In this paper, I have mainly used Mechanical Turk[1], an Amazon's web-based crowdsourcing platform, to collect the crowd's creative ideas for specific products which have either low or high information asymmetry. The sample of experts for product innovation, on the other hand, consists of practitioners from the product-relevant industries and graduate level students with product-relevant major or research concentration. The two products used in the experiments are solar-cell-relevant products and iPhone apps.

The structure of this paper is listed as the following. The first part briefly describes the literature on customers' creative thinking and points out the untested assumption. The second part discusses the definition of product information asymmetry. Then, on the basis of its definition and the componential theory of creativity (Amabile, 1996), the hypotheses are proposed. The third part discusses the experiments, followed by the analysis of results.

THE CROWD'S CREATIVE THINKING—IS IT ALWAYS HELPFUL FOR PRODUCT INNOVATION?

Crowdsourcing Innovation

Crowdsourcing is frequently used by firms via on-line platforms. This term, first introduced by Howe (2006), is the act of outsourcing tasks, traditionally performed by an employee or contractor, to an undefined, large group of people or community (e.g. a crowd), through an open call. Firms are using the crowd online for product innovation. Such phenomenon is defined as *crowdsourcing innovation* in this paper. Half Bakery, Threadless, ImagineCup by MicroSoft and IdeaStorm by Dell have all conducted crowd-sourced innovation through their websites. Individuals in the crowd can be current customers or potential customers of the product providers.

[1] Mechanical Turk is "one of the suites of Amazon Web Services, a crowdsourcing marketplace that enables computer programs to co-ordinate the use of human intelligence to perform tasks which computers are unable to do" (Wikipedia http://en.wikipedia.org/wiki/Amazon_Mechanical_Turk),

Since these individuals are "contributing" their creative thinking to firms via online platforms, does it mean that the "contribution" is always helpful for product innovation? There are two competing streams of research that focused on the legitimacy of the crowd's creative thinking. Both streams of literature focused on customer innovation, which is an alternative form of crowdsourcing innovation from a different perspective.

A specific type of crowd innovation: customer innovation

Advantages:

Many researchers (e.g. Norman and Rmariez, 1993; von Hippel, 2002) have acknowledged the importance of customers, a specific type of the crowd, in product innovation and these researchers also have established theoretical foundations for on-line tools such as open source mechanisms to assist with this specific crowd involvement in product innovation. In the customer-innovation relevant literature, value constellation proposed by Norman, et al (1993), value co-production proposed by Ramirez (1999), co-creation from Prahalad and Ramaswamy (2002) and customer as innovators proposed by Thomke and von Hippel (2002) have occurred sequentially. These theories have not only described the overlapping borderlines between customers and firms, but more importantly, have moved the territories of innovation from R&D groups inside firms to external customers. For instance, Nonaka and Toyama (2002), Pavitt (2002), Richardson (1972), and Venkatraman and Henderson (1998) pointed out that the effective absorbent of external creative technical knowledge is crucial to businesses and, in addition, customers are one of the sources from which both the knowledge for demand and the knowledge of technical needs in product innovation can be obtained (Chan, et al, 2004). Moreover, Thomke, et al., (2002) and von Hippel (2002) pushed customer innovation forward by legitimizing the usage of software toolkits. These researchers' suggestions allowed a number of companies to encourage customers so that these customers can add custom-designed modules to their standard products and then these firms were able to commercialize the best of those complements. Furthermore, researchers (Gibbert, et al, 2002) explored how to sequence customer involvement in order to streamline the innovation process. They discussed five styles of customer involvement for product innovation, including prosumerism (i.e., the customer could fill the dual roles of producer and consumer), team-based co-learning, mutual innovation, communities of creation, and joint intellectual property /ownership. All of the theories legitimized customer innovation from the aspects listed above and encouraged firms to turn to customers, the specific crowd, for creative thinking on product innovation.

Disadvantages:

In contrast, researchers (Bidault, et al, 1994; Bruce et al., 1995; Dolan, et al, 1993; Leonard-Barton, 1999; Schrader, et al., 1998), with the interest in customer innovation, noted the disadvantages of firms outsourcing product innovation to some customers. These researchers concluded that the cooperation between customers and companies does not automatically guarantee success because of the following two problems. One is that customers have limited experience and ability; the other is that the feedback from customers is sometimes uncertain and unrepresentative.

In summary, although so many researchers have explained the importance of the specific crowd in product innovation, none of them validated the underlying assumption of their theories. Thus, whether inside experts' product ideas and outside non-experts' product ideas differ in creativity should be examined before crowdsourcing innovation can be widely encouraged in practice. Such is the main purpose of this paper.

PRODUCT INFORMATION ASYMMETRY

This paper builds on a much-discussed concept from the service marketing literature, information asymmetry, the degree of information asymmetry between customers and product suppliers. This concept implies that all goods/services can be placed on a continuum ranging from '*easy to evaluate*' (search products) to '*difficult to evaluate*' (credence products) (Brush and Artz, 1999; Nelson, 1970). At one end of the spectrum, the products are due to the lack of the knowledge towards these products. On the other end of the spectrum, the *easy to evaluate products* are ones for which their full information can be acquired either before purchase (e.g. we can learn about books prior to purchase) or after certain level of consumption (e.g. after consumption, we learn more about the flavor of one specific food.). The crowd can acquire more knowledge about these products as the consumption increases. Thus, information asymmetry between the crowd and product suppliers is low. On the other hand, for some products, the crowd cannot even verify some of their attributes after use (Klein, 1998; Ostrom and Iacobucci, 1995). These attributes can be very sophisticated technologies so that the crowd either lacks the background knowledge for further understanding or the crowd members are simply not motivated to learn. For example, the crowd, even if intrigued by nuclear power technology, will find this technology intricate to learn. Therefore, high information asymmetry exists in very high-tech products.

For low information asymmetry products, most of their information such as functionality and esthetics is shared, entirely or partially, by both suppliers and customers. Here, the customers are the majority of the crowd I have investigated. Even if experts in firms may know more about the core technology, the crowd, on the other hand, may have product relevant perspectives with greater creativity than experts. One reason is that crowd members, compared to experts inside firms, are outside non-experts. Therefore, the mind of each member is not confined to a particular area. The other reason is that even if these crowd members don't know much about this specific product, they have enough consumption experiences with the product or have other life experiences to borrow from.

In contrast, for high information asymmetry products, information about the core technology or other aspects of the product is blocked from the crowd for two reasons. One is that the crowd in general doesn't consume the product too often; the other is that the technology involved is too boring or difficult to learn. Thus, the crowd does not have enough understanding to generate innovative product-relevant ideas as experts do in firms.

Domain-relevant skills

Domain-relevant skills, as one of the three components of creativity (Amabile, 1996), represent "the ability to learn and apply certain types of domain-specific knowledge" (Taggar, 2002, p.316),. In order to gain these skills, an individual can accumulate familiarity with the domain in question through "memory of factual knowledge, or technical proficiency (Taggar, 2002, p.316)".

As discussed above, for high information asymmetry products, experts within firms have more domain-relevant skills than the crowd, whose majority is customers and non-experts. Considering that there are three dimensions (practicality, novelty and

acceptability (Dean, Hender, Rodgers and Santanen, 2006) of measuring creativity of one idea, I have proposed the first set of hypotheses as follows:

H1a. For high information asymmetry products, experts inside firms can provide product ideas of greater novelty than outside non-experts.

H1b. For high information asymmetry products, experts inside firms can provide product ideas of greater practicality than outside non-experts.

H1c. For high information asymmetry products, experts inside firms can provide product ideas of greater acceptability than outside non-experts.

For low information asymmetry products, experts within firms have relatively the same level of domain-relevant skills as that of the crowd, most of whom are customers and non-experts. The relevant hypotheses are:

H2a. For low information asymmetry products, non-experts outside of firms can provide product ideas of the same level of novelty as experts inside firms.

H2b. For low information asymmetry products, non-experts outside of firms can provide product ideas of the same level of practicality as experts inside firms.

H2c. For low information asymmetry products, non-experts out of firms can provide product ideas of the same level of acceptability as experts inside firms.

In summary, considering that the creativity of one person's idea depends on the amount of domain-relevant knowledge he or she has, I have proposed my last three hypotheses:

H3a. Whether inside experts' product ideas and outside non-experts' product ideas differ in novelty depends on product information asymmetry.

H3b. Whether inside experts' product ideas and outside non-experts' product ideas differ in practicality depends on product information asymmetry.

H3c. Whether inside experts' product ideas and outside non-experts' product ideas differ in acceptability depends on product information asymmetry.

METHODOLOGY

Description of Experimental Design

Two experiments were designed to fit into two theoretical scenarios: high information asymmetry products and low information asymmetry products. For the former, I selected a solar-cell-related product because its consumption is not very high in a global perspective. And due to the high complexity of embedded technology, people might not be very interested in learning the technology even if they have purchased the product. For the latter, I chose iPhone apps because when compared to solar-cell-related products, iPhone apps enjoy a high popularity world-wide and even unconsciously, people are willing to spend money and time to learn these applications. For each product (either iPhone apps or solar-cell-related products), I asked the crowd, whose majority is customers, as well as experts to provide a creative idea. In order to minimize unnecessary measurement errors, I didn't introduce any information about either product in the experiment and only asked for one creative idea about each product in the idea collection phase. This would allow me to include only the knowledge possessed by subjects before they participated in these experiments.

There were two phases in each experiment. One consisted of the creative idea collection described above; the other consisted of idea evaluation. All the ideas were in the form of verbal presentations (Vriens, et al, 1998). In order to rank them, I asked participants from Mechanical Turk (Kittur, 2008) to rate these ideas from 1 to 7 with 7 representing the most creative idea. To measure "innovative", I used multiple items to ensure the internal validity of the measurement. The three items were novelty, practicality and acceptability of one idea (Dean, et al, 2006).

I compared subjects' evaluation ratings of ideas based on two conditions: "ideas are provided by experts" and "ideas are offered by the crowd". In the experimental design, an intervention of the information asymmetry embedded in products was deliberately introduced to observe its effects (Mosteller, 1990; Winston, 1990; Winston and Blais, 1996).

Stimulus-Set Construction

Independent variable: The type of idea provider (IP)

To examine whom we can turn to for creative thinking, I distinguished experts in the company and non-experts outside. The term of outside non-experts was represented in the study as "the crowd" and the majority of the crowd was composed of existing customers or potential customers of a certain product. In this study, I asked both experts and non-experts to generate one creative idea on each product. However, due to individuals' different industrial experiences or education, there existed experts in the crowd. For the purpose of examining the extreme case of the comparison between experts' ideas and the crowd's ideas, I eliminated experts in the crowd sample. To be more precise, I identified and only included both current customers (who have purchased at least one product already) and the potential ones (whose desire to purchase either product is above 4 with 7 representing the maximal desire) as the crowd sample. Thus, the independent variable for my data analysis is categorical: expert or non-experts.

For the measurement of the independent variable, I used multiple items: major (categorical), relevant courses taken (categorical) and product development experience (continuous: a 7-likert scale, with 7 representing the maximal value). To guarantee that an idea provider is an expert in the domain of either product, I stressed that s/he must simultaneously have at least one of my listed majors, one of the listed courses and his/her product development experience is above 4. Otherwise, s/he is a non-expert.

Moderator: The level of product information asymmetry (IA)

To consider that product characteristics can influence the results, the level of information asymmetry in products was investigated. I purposely chose two products such that one (solar-cell-related products) represents the high level and the other (iPhone apps) represents the low level of information asymmetry. Thus, the moderator is also categorical: either low or high information asymmetry.

Dependent variable: Idea creativity

In the experiments, ideas' perceived creativity was inquired from subjects. Three items (practicality, novelty and acceptability (Dean, et al, 2006), representing the creativity of ideas, were examined on a 7-likert scale to ensure internal validity (For correlations among the three, see Table 1)

Variables	Expert ideas				Non-expert ideas				Correlation		
	Mean [a]	Mean [b]	Sd. [a]	Sd. [b]	Mean [a]	Mean [b]	Sd. [a]	Sd. [b]	1	2	3
1.Practicality	4.99	5.00	0.7	.75	4.50	4.76	.95	.79			
2.Novelty	5.47	5.11	.74	.60	4.02	4.9	.94	.76	.0.45** [0.00] [a] 0.49** [0.00] [b]		
3.Acceptability	5.22	5.19	.71	.82	4.79	5.05	1.13	.8	0.8** [0.00] [a] 0.8** [0.00] [b]	0.46** [0.00] [a] 0.48** [0.00] [b]	

Table 1. Descriptive statistics and correlations [c]

a. About Solar cell-related products

b. About iPhone apps

c. Based on the crowd's ratings

. †p < .10

*p < .05

**p < .01

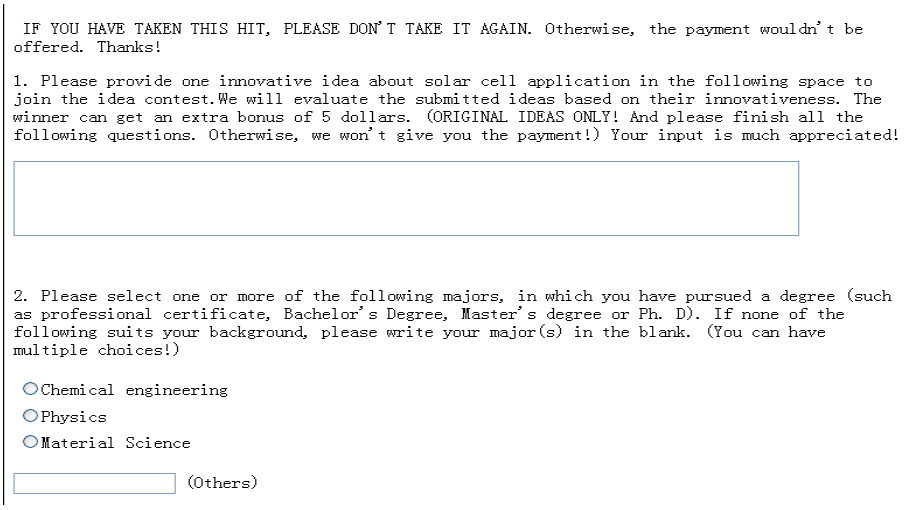
Two-tailed test

Sample and data collection

For the solar-cell-related product experiment, a sample of 22 experts' ideas and that of 30 non-experts' ideas were selected. For the iPhone-apps experiment, 18 experts' ideas and 30 non-experts' ideas were obtained in the idea collection phase.

In this phase, some of the subjects were turkers from Mechanical Turk (Kittur, et al, 2008); the others were experts, who were either from product-related industries or graduate-level students with related majors. Due to the difficulty in finding experts, under both conditions of solar-cell-related products and iPhone apps, I included the ideas of experts I had access to and those of experts identified on Mechanical Turk. I then ran a t-test between the ratings of ideas generated from the two groups of experts. The data analysis' results indicated no significant difference. Thus, the assumed homogeneity in collected experts' ideas is supported.

Hits for collecting ideas were posted simultaneously on Mechanical Turk and this action ensured a high level of homogeneity in the sample for idea collection (See Figure 1 for the example of innovative idea collection for solar-cell-related products). After ideas related to both products were collected, a separate group of subjects were simultaneously confronted with the verbal representations of ideas (Vriens, M., et al, 1998) and were asked to rate these ideas. And this again ensured homogeneity in the sample for idea evaluation. In the evaluation phase, every idea in both product conditions was evaluated by five people in the crowd.


IF YOU HAVE TAKEN THIS HIT, PLEASE DON'T TAKE IT AGAIN. Otherwise, the payment wouldn't be offered. Thanks!

1. Please provide one innovative idea about solar cell application in the following space to join the idea contest.We will evaluate the submitted ideas based on their innovativeness. The winner can get an extra bonus of 5 dollars. (ORIGINAL IDEAS ONLY! And please finish all the following questions. Otherwise, we won't give you the payment!) Your input is much appreciated!

2. Please select one or more of the following majors, in which you have pursued a degree (such as professional certificate, Bachelor's Degree, Master's degree or Ph. D). If none of the following suits your background, please write your major(s) in the blank. (You can have multiple choices!)

- Chemical engineering
- Physics
- Material Science

(Others)

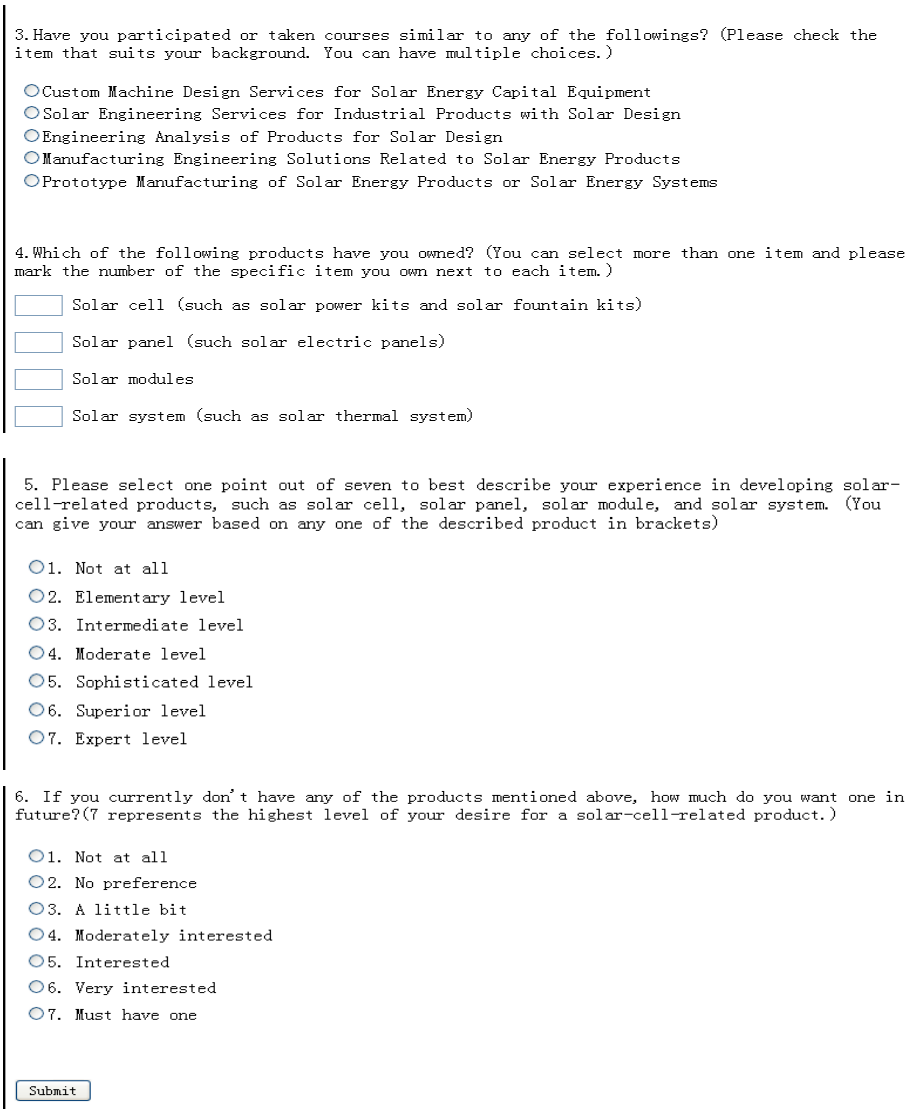


Figure 1. The survey example of innovative idea collection for solar-cell-related products on Mechanical Turk

RESULTS

The Moderating Effect on the Creativity Difference between Ideas from Both Experts and Non-experts

In order to compare the creativity difference between ideas provided by both experts and non-experts, in either experiment, I used between-subject t-test. Table 2 represents the result of the statistical analysis.

Variables	Solar cell-related product			iPhone apps		
	Mean [a]	Mean [b]	T-tests (p-value)	Mean [a]	Mean [b]	T-tests (p-value)
1.Practicality	4.99	4.50	*	5.00	4.76	[0.35]
2.Novelty	5.47	4.02	**	5.11	4.9	[0.37]
3.Acceptability	5.22	4.79	†	5.19	5.05	[0.60]

Table 2. Result of t-tests on the creativity of Ideas generated from both experts and non-experts [c]

a. Experts' idea
b. Non-experts' idea
c. Based on the crowd's ratings
.†p < .10
*p < .05
**p < .01
Two-tailed test

High Information Asymmetry Product: Solar-cell-related Products

In contrast of ratings for iPhone-apps-related ideas, for solar-cell-related products, the average novelty rating of experts' ideas is 5.47 (with 7 representing the maximal value), much above that of non-experts' ideas: 4.02. In the t-test analysis for novelty rating, the difference is significant, with a p-value lower than 0.05. Thus, Hypothesis 1a is supported. The same result is also drawn in the analysis of practicality and acceptability ratings for solar cell-related product. For practicality, the average rating of experts' ideas is 4.99 and it is much higher than 4.5, which is the average rating of non-experts' ideas. Also, the increase is statistically significant, with a p-value below 0.05. For acceptability, there is a significant difference between the rating of experts' ideas and that of non-experts' ideas. Thus, Hypothesis 1b and 1c are both supported by the data (See Table 2).

Low Information Asymmetry Product: iPhone apps

For iPhone apps, the average novelty rating of experts' ideas is 5.11 (with 7 representing the maximal value), a little above the average rating of non-experts' ideas: 4.9. However, the p-value is above. 0.1, indicating that there is no significant difference between the ratings of ideas provided by both experts and non-experts. Thus, Hypothesis 2a is supported. Similarly, no significant difference exists between the practicality ratings of experts' ideas and those of non-experts' ideas, even if the average of the former is a little higher than that of the latter. Thus, Hypothesis 2b is also supported. Moreover, from the analysis of t-test, the same conclusion is drawn for the acceptability rating. The average acceptability rating of experts' ideas is 5.19 and it is a little higher than that of non-experts' ideas, with a p-value higher than 0.1. This indicates no significant difference between the acceptability ratings of experts' ideas and those of non-experts' ideas. Thus, Hypothesis 2c is supported as well. (See Table 2)

	Type III Sum of Squares		
Dependent variables:	Idea Novelty	Idea Practicality	Idea Acceptability
IA (Binary)	2.617*	0.386	0.317
IP (Binary)	19.171**	2.411†	3.125*
IA*IP	8.709**	0.351	0.514
Residuals	58.539	73.726	61.169

Table 3. Result of the ANOVA test[c]

c. Based on the crowd's ratings
.†p < .10

*p < .05
**p < .01

To test if there is a significant interaction between the two variables: the type of idea provider (IP) and the level of product information asymmetry (IA), I also coded them as binary (1 for high IA, 0 for low IA, 1 as experts for IP and 0 as non-experts for IP) and accordingly ran ANOVA (Baron and Kenny, 1986). Table 3 shows that only the interaction for idea novelty is significant. Thus, H3a is supported; H3b and H3c are both rejected.

In summary, for low information asymmetry product, the difference between the creativity rating of experts' ideas and that of non-experts' ideas is not significant. In contrast, for high information asymmetry products, experts' ideas are significantly more creative than those of non-experts'. Moreover, the moderating effect imposed by the level of information asymmetry in products is significant for idea novelty (See Table 3).

CONCLUSION

Although prior literature (e.g. Chan, et al, 2004; Howe, 2006; von Hippel, et al, 2002) recommended the usage of crowd involvement in product innovation, whether or not the crowd can provide creative thinking for product innovation has not been formally tested. This empirical research represents one first step in understanding the ways in which firms are attempting to utilize the crowds' knowledge for creative thinking for products.

Imposed by the level of information asymmetry embedded in products, a moderating effect was found when comparing the creativity ratings of ideas provided by experts within firms against those by non-experts in the crowd. For high information asymmetry product, such as solar cell-related products used in this paper, firms would be better off if they directly ask experts for advice; in contrast, when innovating with low information asymmetry products, such as iPhone apps, firms can ask either experts inside firms or the crowd who are outsiders for creative thinking.

LIMITATIONS

In this paper, I used iPhone apps to represent the low information asymmetry embedded in products as a contrast to solar-cell-related products that represent the other extreme. However, compared to other products such as chairs, iPhone apps have a higher information-asymmetry level. Therefore, in theory, iPhone apps are not the ideal products for testing asymmetry. The finding about iPhone apps suggests that, although in general the difference between the creativity ratings of ideas provided by experts within firms and those by non-experts in the crowd is not significant, the novelty rating of ideas generated from experts (with the average of 5.00) is higher than that from non-experts in the crowd (with the average of 4.76); the same applies for the practicality rating (with the average of 5.11) and acceptability rating (with the average of 5.19) of ideas from experts (See Table 2). Perhaps products representing extremely low information asymmetry might be moderately different. Nevertheless, for low information asymmetry products, there is no significant creativity difference between ideas provided by both experts within firms and non-experts in the crowd.

Moreover, I included both the current customers who have purchased the products and potential customers who have the desire to purchase as customers, and treated current customers and potential ones as non-experts in the crowd as opposed to experts

within firms. However, theoretically, there should be a difference between customers and the crowd. More future effort needs to be paid to distinguish the crowd and customers in the sense of providing innovative ideas for products.

IMPLICATIONS

With the increase of web applications' capabilities over the past two decades, the capabilities for crowdsourcing techniques have been greatly increased, and now the term *crowdsourcing* often refers exclusively to web-based activity. Many innovation requesters, such as firms, are using the crowd online (for example from Mechanical Turk, 99designs, and CrowdSpring) for innovative ideas or innovation. Thus, from a managerial perspective, this research is intended to help managers to take a strategic approach to leveraging the crowds' knowledge in web-based crowdsourcing. It also provides a detailed framework to guide managerial decision-making related to the crowds' knowledge.

From what has been discussed in this paper, at least firms will know, by using web-based crowdsourcing tools, to whom exactly they can outsource innovation development. For products with high information asymmetry, firms can outsource innovation directly to experts; for low information asymmetry products, firms can ask either experts within firms or non-experts in the crowd for innovative ideas.

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